AN UNUSUAL AUSTRALITE FROM KOOKYNIE, WESTERN AUSTRALIA

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ABSTRACT

A bluntly conical feature on the posterior flight surface of an australite core is interpreted as the basal remnant of a 'tail' on the parental australite body.

A round australite core (W.A. Museum no. 1645) from Kookynie (29° 20'S., 121° 30'E.) is unique in my experience in having upon its posterior surface of flight a small, truncated, conical protuberance resembling in profile a miniature volcano (**Fig.1**).

Though somewhat abraded, the australite is better preserved than many recovered from semi-arid terrain. Minor sculpture on the posterior surface includes some lightly etched schlieren. The approximately radial pattern of these schlieren on the flanks of the conical structure shows that the internal flow lines converge upward into the cone. The rim is regular and well defined. The equatorial zone, 1.0 — 1.2 cm wide, is limited anteriorly by a distinct shoulder. The anterior surface is irregular in form and its profile is asymmetrical with a blunt peak (arrowed in Fig. 2) which is not antipodal to the conical structure on the posterior surface.

The dimensions of the core are 3.04 x 3.01 x 2.66 cm, the mass 29.256 g and the specific gravity 2.456. The radius of curvature of the posterior surface in the plane of the posterior pole and the width dimension was accepted as the radius of the primary body because the profile in that plane is unaffected by the presence of the conical structure. The same radius was therefore used in the reconstruction through the length dimension (Fig.2), where the conical structure accounts for the slightly larger dimension and makes the estimate of original diameter less reliable.

The diameter (thickness) of the parent sphere was 3.35 cm and its volume, including an estimated 0.22 cm^3 for the remnant conical structure, was c.19.90 cm^3. Thickness and volume losses from the parent body, principally by ablation and the stress shell, were approximately 20% and 40% respectively.

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ORIGIN OF THE CONICAL STRUCTURE

The conical structure on the posterior surface, a weathered remnant (28%) of the primary surface, is likely to date from the period of formation of the primary body because there is no evident way in which it could form upon the cold, rearward-facing surface during atmospheric transit. An upstanding primary feature would be retained if high viscosity resulting from unusual chemistry or from lowered temperature prevented the adoption of a spherical shape. It would be of interest to know the refractive indices of various parts of the core as a guide to silica content and viscosity, but measurement was impracticable.

An extensive volume of material of unusual composition would affect the specific gravity of the core but it is an expected value for the site of find. The modal values for large samples of australites from Boyce Creek (50 km to the S.E.) and from two more distant localities in the region are in the range 2.45 — 2.46 (Chapman 1971), within which lies also the value for the Kookynie specimen. An extensive anomaly in mass distribution associated with the conical structure would be expected to cause alignment of the structure with the flight axis, as has occurred with unusually large bubble cavities (Baker 1966 fig.1), or alternatively, to cause some instability in flight. The regular rim and width of equatorial zone suggest that this australite, like nearly all others, was stably oriented during ablation flight. A more localized compositional and mass anomaly might be possible in the same way that bubbles of more modest size can occur well off the flight axis in stably oriented specimens.

Fig. 1. Oblique view of australite from Kookynie emphasising posterior surface and blunt conical structure at upper left.

A ‘tail’ could originate by the drawing out of material during detachment of the primary body from the mass of original melt. Chapman (1964) has figured the tailed spherules which were the most common form produced when melt of high viscosity was used in experiments designed to simulate formation of primary bodies. Such bodies often had a pinched ‘nose’, not necessarily aligned with the tail (Fig.2), which suggests that the anterior asymmetry of the Kookynie specimen could be inherited from a surface feature of the primary body. However, asymmetry of the surface exposed by loss of the stress shell is sufficiently common for its presence on the Kookynie specimen to be fortuitous.

Much smaller (∿ 1 mm), tailed, glass spherules from various sources have long been known, for example, amongst the ‘smoke bombs’ of coal-burning locomotives (Fenner 1934), and more recently amongst the so-called ‘microtektites’ of deep ocean sediments (Glass 1968). The retention of the tails on small primary forms was a consequence of their rapid solidification. The survival of a tailed form amongst australites would likewise require a high degree of viscosity, and additionally, a flight orientation which would afford some measure of protection during atmospheric transit. When the reconstructed australite is compared with a very small form (Fig.2), its tail appears disproportionately short. A longer cooling history would allow some resorption of the tail into the ideal spherical form until the process was terminated by increasing viscosity.

The drawing apart of primary bodies following glancing collision is con-

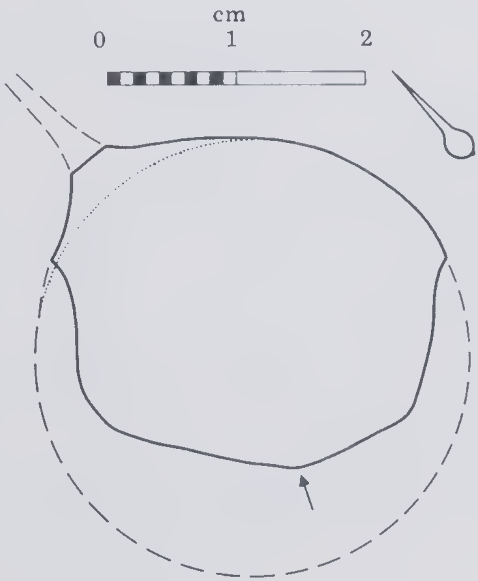

Fig. 2. Profile of australite core (firm line) with partial restoration of primary form (broken lines). The dotted line indicates the ideal spherical surface. Direction of flight towards bottom of page. At upper right, generalised form of tailed spherules produced in experimental formation of primary bodies.

sidered an unlikely mechanism for producing the structure because of the perfection of curvature of the remnant of the primary surface. It would be necessary to postulate that little distortion resulted from collision, or that the shape was restored except in the vicinity of the drawn out material.

The rise of a gas bubble towards the surface might produce the structure if the present concavity of the flanks was immediately succeeded by convexity above. Bubble pits resulting from degassing in the primary stage of formation are so common on the posterior surfaces of the better preserved australites that it would be surprising if generally similar structures over shallow bubbles had not previously been observed.

Dismissing any thought of destructive examination of this rare specimen, the origin of the conical structure must remain in some measure a matter of conjecture. The favoured view is that the structure is the base of the tail formed during detachment of the primary body from the parent melt, and that it was retained — at least in part — because of high viscosity arising from unusual, but localised, chemical composition. The base of the structure was protected during flight through the atmosphere but its height could have been reduced by ablation because the region of 'dead air' behind a sphere is conical (Baker 1958 fig.1). Alternatively, since the blunted top of the cone is approximately at right angles to its axis, the relatively fragile part of the tail could have been lost on impact or since arrival on the earth's surface, and the scar later smoothed by abrasion.

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